

Appln. No. 10/614,626
Amdt. dated: August 8, 2005
Reply to Office Action dated: May 20, 2005

Remarks/Arguments

These remarks are in response to the Office Action dated May 20, 2005. This reply is timely filed.

At the time of the Office Action, claims 1-21 were pending in the application. Claims 1-15 have been allowed. Claim 20 has been rejected under 35 U.S.C. §102(b). Claims 16-20 have been rejected under 35 U.S.C. §103(a). The rejections are set out in more detail below. Claim 21 has been cancelled. New claims 22-25 have been added.

I. Brief Review of Applicants' Invention

Prior to addressing the Examiner's rejections on the art, a brief review of Applicants' invention is appropriate. The invention relates to improvements in microwave horn antennas. Frequency selective surfaces (FSS) have been used in conventional horn antennas. For example the FSS can be used to form a second horn within a first horn. Forming the second horn of a FSS minimizes the effect that the second horn has on the performance of the first horn. Still, one problem with the use of FSS for horn antennas is that the FSS is known to generate grating lobes. Grating lobes are scattered beams of electromagnetic energy directed by the horn in uncontrolled directions. Grating lobes result from transmitted and scattered plane waves which do not obey Snell's laws of reflection and refraction. Grating lobes are caused by relatively large inter-element spacing within the FSS, large angles of incidence of plane wave with respect to surface, and/or both. Importantly, grating lobes adversely affect horn antenna performance.

The present invention solves the problem of grating lobes produced by horns made from FSS. The foregoing result is accomplished by forming the FSS on a substrate that has a relative permittivity and/or a relative permeability that are relatively

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high as compared to the environment surrounding the FSS (which is usually air). This technique reduces grating lobes in horn antennas formed of an FSS.

II. Claim Rejections under 35 U.S.C. §102(b).

Claim 20 has been rejected under 35 U.S.C. §102(b) as being anticipated by International Application No. WO 94/00892 to Vardaxoglou (Vardaxoglou). However, based on the Examiner's comments in paragraph 4 of the Office Action, it appears that the Examiner's rejection actually was intended to refer to claim 21. Claim 21 has now been cancelled.

III. Claim Rejections under 35 U.S.C. §103(a)

Claims 16-20 have been rejected under 35 U.S.C. §103(a) as being unpatentable over Vardaxoglou in view of U.S. Patent No. 6,512,494 to Diaz et al. Vardaxoglou discloses a horn antenna that is formed of an FSS. However, Vardaxoglou entirely fails to recognize the grating lobe problem, which is created by using an FSS construction. Diaz et al. discloses a multi-resonant high impedance electromagnetic surface. However, Diaz et al. also fails to recognize the grating lobe problem that is caused by using an FSS to construct a horn antenna. In fact, neither of the cited references even discuss grating lobes.

According to the Examiner, it would have been obvious to provide the FSS of Vardaxoglou with the substrate having high permeability and permittivity as taught by Diaz et al. However, in making this rejection, the Examiner appears to be engaging in a hindsight reconstruction of the Applicants' claimed invention. With regard to claims 16 and 18, neither of the cited references suggests that the permittivity or permeability of

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FSS surfaces in a horn antenna should be increased to values above 3 for improved performance. Similarly, with regard to claim 20, neither of the references teaches reducing a grating lobe by decreasing the spacing between adjacent elements of a frequency selective surface.

In determining the differences between the prior art and the claims, the question under 35 U.S.C. 103 is not whether the differences themselves would have been obvious, but whether the claimed invention as a whole would have been obvious. See MPEP §2141.02 and cases cited therein. In the present case, there is no teaching in the cited references that relates to the advantages of higher permittivity and/or permeability values for reducing grating lobes in horn antennas formed from an FSS. Accordingly, Applicants do not believe the cited references can be sufficient to support the Examiner's obviousness rejection with regard to claims 16-20.

In order to render a claim unpatentable as being obvious over a combination of prior art references, there must be some suggestion or motivation to combine the references. The Vardaxoglou and Diaz et al references do not teach or suggest a solution to the grating lobe problem. Moreover, neither of the cited references even recognizes the problem to be solved, i.e. reducing or eliminating grating lobes in horn antennas constructed from FSS. Given the foregoing, there is nothing to suggest that the claimed invention would have been within the knowledge of persons of ordinary skill in the art. Accordingly, Applicants believe that the Examiner's rejection of claims 16-20 under 35 U.S.C. §103(a) should be withdrawn.

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IV. New Claims


New claims 22-25 have been added to emphasize the features of the claimed invention that relate to improved grating lobe performance. The claims also recite as a further limitation that the FSS can have a characteristic impedance that is approximately the same as the environment in which it is operating. Matching the characteristic impedance to the operating environment can further optimize the performance of the claimed horn antenna. Four (4) new dependent claims have been added. Please charge Deposit Account 50-2884 in the amount of \$200.00 pursuant to 37 CFR 1.16(i).

V. Conclusion

Applicants have made every effort to present claims which distinguish over the prior art, and it is believed that all claims are in condition for allowance. Nevertheless, Applicants invite the Examiner to call the undersigned if it is believed that a telephonic interview would expedite the prosecution of the application to an allowance. In view of the foregoing remarks, Applicants respectfully request reconsideration and prompt allowance of the pending claims.

Respectfully submitted,

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Date


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